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The effects of positive and negative retrieval cues on release from retroactive interference

Michael P. Etgen

Abstract

The following study examined the effects of positive and negative retrieval cues within a release from retroactive interference design. Predictions based upon a modification to the cue-overloading hypothesis were evaluated. Subjects were 79 Introductory Psychology students. They learned two lists, each composed of four-legged animals, and were tested for recall of the originally-learned list. Informed subjects were supplied with a retrieval cue for the interpolated list to provide a release from retroactive interference. All subjects were further divided into those who were released by becoming aware during original learning and those who were not. Comparisons revealed a reliable and comparable degree of release for both postinformation groups as well as the uninformed-aware group. Further, released subjects who used semantically-based (positive) retrieval cues exhibited a lower rate of forgetting over the two-week retention interval than those who used episodically-based (negative) cues, though the difference was nonsignificant. Implications for future research within a proposed theoretical framework are discussed.

The Effects of Positive and Negative Retrieval Cues

on Release from Retroactive Interference

By

Michael P. Etgen

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I certify that I have read this thesis and find that, in scope and quality, it satisfies the requirements for the degree of Master of Arts.

Kenneth A. Blick
____
Committee Chair - Dr. Kenneth A. Blick

L. James Tromater
____
Committee Member - Dr. L. James Tromater

Jane M Berry
____
Committee Member - Dr. Jane M. Berry

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The Effects of Positive and Negative Retrieval Cues on Release from Retroactive Interference

The systematic study of the role of interference in forgetting began around the turn of the century. An early query into the general idea that forgetting may be due to later events interfering with earlier events, was conducted by Muller and Pilzecker (1900). The basic format for that study, and the majority of others concerned with interference, consisted of an experimental group learning two lists of words or letters, and a control learning just the first list. The control group would engage in a distracter task while the experimental group learned the second list and completed a shorter distracter. Both would then recall that first list. The experimental group's decrement in performance revealed the phenomenon termed retroactive interference (RI).

The major theoretical explanation afforded RI was primarily espoused by McGeoch (1942). He proposed a theory of forgetting that employed competition at recall as the major cause of forgetting. The competition between pieces of information produces interference and thus forgetting. In terms of an A-B / A-D paradigm, the learning of A-D (interpolated material) following A-B (original material) will produce competition between the response sets when asked for the original response /B/ because of its stimulus cue similarity to the interpolated response /D/. Interference is not a problem when new information is unlike that previously learned. The stimulus cue for the new information must be the same or highly similar to the cue for the old information for interference to occur.

A second type of interference is proactive interference (PI). In the A-B / A-D paradigm, the subject's learning of A-B interferes with the recall of the target list, A-D. Thus, PI is different from RI in that the subject's past learning interferes with future learning, as opposed to future learning interfering with past learning. Although different in procedural elicitation, the underlying mechanism is considered essentially the same - interference (Bower & Mann, 1992).

Watkins and Watkins (1975) proposed the cue-overloading hypothesis to explain the interference produced in both PI and RI studies, as well as a solution to overcoming interference. The first half of the cue-overloading hypothesis states that a retrieval cue becomes less effective as more units are associated to it, and when it is similar to other retrieval cues associated to other units (Brent, 1965; Bower, 1969). The second half states that interference will be reduced by cues that more clearly specify or organize the desired targets, rather than the interfering material. The second half of the cue overloading hypothesis was necessary to account for the results of the release from PI experiments reported by several researchers in the 1960's (see Wickens, 1970).

The release from interference in general has been well documented over the past 25 years, but the lack of a theoretical framework has created a rather confusing picture of the processes underlying releases. Further, there have been some results that clearly contradict the second half of the cue-overloading hypothesis (Zimmerman, 1954; Bower & Mann, 1992; Etgen & Blick, 1994, March). Therefore, a review of the release from interference literature will be made within a newly proposed framework so that this research may be placed into perspective. The framework will provide the opportunity to focus effort on areas where knowledge is particularly unclear or lacking.

A Release from Interference Framework

I propose a new framework that incorporates all forms of release from interference. The names of the different types of release are categorized according to the designs and methods used to elicit them (see Figure 1 for a diagram). Some of the releases in the framework have been supported by empirical research while others have been unexplored as of yet.

Insert Figure 1 about here

A closer inspection the diagram reveals that the release from interference in general is the root of the tree. At the first differentiation in the outline, we must divide the studies into those dealing with RI and those dealing with PI. As a second point of departure, we must further divide both of these designs into those with "direct" and those with "indirect" cueing methods. A brief departure from the diagram is in order here so that I may explain the above new terms.

It is meant by the "direct cueing method" that the experimenter's information for release is solely about that list which the experimenter wishes to be recalled (i.e. the target list). For example, if I were conducting a PI experiment with direct cueing, I would release the subjects from interference by supplying information about the last list learned (target list).

It is meant by the "indirect cueing method" that the experimenter's information is solely about the interfering material. For example, if I were conducting an RI study with indirect cueing, then I would release the subjects from interference by supplying information about the last list learned (interpolated list).

The final distinction to be made in the diagram is that of when the releasing information will become available to the subjects. When the releasing information is given prior to original learning, the subject will experience a "preinformation" release. The preinformation release could also be thought of as an "encoding" release because the knowledge of the retrieval cue helps the subject encode the information in an easily retrievable form. When the releasing information is given after original learning, the subject will experience a "postinformation" release. The postinformation release can also be thought of as a "retrieval" release because the late-arriving knowledge of the retrieval cue helps to organize the previously-learned information, thus producing better recall. Finally, when subjects become aware of the releasing information on their own during original learning, they will experience an "awareness" release. The awareness release can be thought of as a combination of both an encoding and retrieval release. An awareness released subject would be able to encode some items of the list in the same manner as a preinformed subject. She would have to rely upon the organized retrieval provided by the cue though, much like a postinformed subject, for items seen before cue awareness. Thus, the time at which the differentiating retrieval-cue becomes salient for the subject further divides the direct and indirect releases from interference into three categories. Therefore, it is proposed that there are 12 different methods for achieving a release from interference. The following studies represent a concise review of the major findings in the release from interference area as well as shed more light upon the theoretical utility of the proposed framework.

Past Research

Wickens and Clark (1968) conducted an experiment using triads of words positively or negatively rated on the Osgood, Suci, and Tannenbaum (1957) connotative meaning axes (see Wickens, 1970, for a more complete description of the word ratings). The Osgood rating consisted of three axes: Evaluative, Potency, and Activity. Words were positively or negatively rated along these axes. Words were chosen that rated highly on a dimension of one axes, but neutrally on the other axes. The basic design of the experiment was to present homogeneous triads in the first four lists, then shift to triads from the opposite dimension for the fifth list. Subjects were not specifically informed of this shift by the experimenter. Groups were tested separately on each of the axes. The researchers were particularly interested in how PI may be induced and then possibly reduced by the shift. The build up of PI was quite evident over the first four lists, with recall of the fourth list decreasing 35% from first list recall. But the recall of the fifth list showed dramatic recovery for all axes triads. The fifth list recall increased approximately 20% on average from the fourth list recall. The difference between the control (fifth list did not shift) and experimental groups' recall was approximately 25%. Thus, the dimensional shift in the fifth list to something different from the first four lists provided subjects with a release from PI. In terms of our framework, this was a direct-awareness release from PI. The subjects encoded some of the target list differently during the learning phase and were able to produce other items through organized retrieval, and thus recalled more target items.

Other studies conducted around the same time as the above experiment utilized different types of shifts. Reutener (1969) provided impressive results with an experiment in which he studied the effect of shifting between triads of miscellaneous nouns and triads of spelled-out numbers. In that same study, he also found a significant release by shifting between arabic numerals and spelled-out numbers. Other successful shifts were made with taxonomic class (Loess, 1967), sense impressions (Underwood & Richardson, 1957), word frequency (Swanson, 1969), and semantic differentials (Wickens, Born & Allen, 1963; Wickens, 1970). Less prominent but still significant shifts were found with slide backgrounds (Turvey & Egan, 1969), figure-ground differences (Reutener, 1969), and acoustic-articulatory differences (Baldwin, 1969). All of these studies provided much additional support for the direct-awareness release from PI. It has proved to be quite robust and generalizable to many stimuli and situations.

Gardiner, Craik, and Birtwistle (1972) carried the idea of the release from PI a step further with an innovative design modification. Their subjects studied triads of words and then recalled them after a 30-sec. retention interval. The first three sets of items belonged to a subcategory of a large general taxonomic category ("garden flowers" as a subset of "flowers"). On the critical fourth trial, the triads belonged to a different subcategory (wildflowers). The researchers were interested in the effect of encoding items under a general taxonomic category as opposed to the more specific subcategory. The control subjects were given no indications and continued to encode the items as just more flowers, and thus PI was pronounced. Other subjects were instructed to encode the fourth set of triads as "wildflowers", and thus showed a release from PI with much higher recall. In terms of the framework, those subjects experienced a direct-preinformation release from PI.

The final group of subjects always received the retrieval cue after the retention interval distracter and just before recall. The cue given them for the first three trials was the general category of “flowers”, but the cue given for the fourth was the more specific subcategory. These subjects also showed a release from PI, equal to that of the other release group. The above design modification produced what Gardiner, Craik and Birtwistle (1972) termed a “delayed release from PI”, in that the subjects had previously encoded the sets of triads much the same as the control group. In spite of this, they were able to show the same magnitude of release from PI as the other release group when supplied with the subcategory retrieval cue just before recall. In terms of the framework, those subjects were an example of a direct-postinformation release from PI group.

The body of work concerning the release from interference research with RI is much less complete than with PI, but there are some notable studies which utilized RI. Tulving and Psotka (1971) provided an illustration of the cue-overloading hypothesis as applied to the release from RI. Their subjects learned varying numbers of multi-categorized lists, and were then asked to recall the first list learned. The researchers found that the more interpolated lists learned, the greater the RI. This result supported the prediction of the first half of the cue-overloading hypothesis. As more lists were learned, subjects associated more units to the original retrieval cues as well as attempted to encode other items under retrieval cues similar to the original ones. That process reduced the effectiveness of the original retrieval cues, thus inducing RI. Tulving and Psotka (1971) further found that subject recall was vastly improved when they were cued with the specific categories found in the first list, which provided evidence for the second half of the hypothesis. As those original retrieval cues became more distinct from the subsequent ones, subjects experienced a release from RI. In terms of the framework, those subjects experienced a direct-postinformation release from RI.

A study by Zimmerman (1954) provided slightly different results from what one would expect in light of the second half of the cue-overloading hypothesis. Zimmerman's subjects first learned a list of 21 random letters, and then a second list that spelled "wealthy bankers holiday" backwards. Then the subjects completed a serial recall of the original list. The interference group was unaware of the second list organization while learning and thus recalled the target list quite poorly. One of the release groups was told the organizational cue immediately before learning that list and recalled the first list quite well (an indirect-preinformation release from RI). A final release group was told the retrieval cue just before target list recall, and recalled essentially the same as the other released group (an indirect-postinformation release from RI).

Notice that a difference in experimental method is found when considering the above mentioned study in contrast to the previous studies. The implications are evident here when one considers the second half of the cue-overloading hypothesis. In all of the previous studies, the late-arriving retrieval cue helped subjects to organize the target material, partitioning it off from the interfering material, and elevating recall (second half of cue-overloading hypothesis). In the Zimmerman (1954) study, the interfering material was organized. Thus, information that could organize the interfering material after it had been learned also seemed to boost recall of the target material. This is clearly in opposition to the claim of the second half of the cue-overloading hypothesis, which asserts that the retrieval cue must directly refer to the target material. In fact, one may predict from the cue-overloading hypothesis that any information given about the interfering material would only prime the subjects for that information and thus decrease availability of target items. So, evidence for any type of indirect release from interference runs counter to the second half of the cue-overloading hypothesis.

In light of the results of Zimmerman's (1954) study, many questions arise. Did the subjects actually revive and reindex the interfering list? If so, how could the subjects do it so quickly when they are given so little time to do so? How did this increase the recall of the target material? Can we reconcile these results with the second half of the cue-overloading hypothesis? Zimmerman's (1954) study contained a certain small procedural factor that could account for her results. Bower and Mann (1992) conducted a series of studies in order to further clarify the indirect-postinformation release from RI as found by Zimmerman (1954).

Bower and Mann (1992) addressed the postinformation release in a series of four studies. The first two utilized lists of letters in an attempt to replicate and elaborate upon the research of Zimmerman (1954). A slight change to the method of the original study characterized the design of Experiment 1. Zimmerman (1954) allowed the subjects to briefly review the interpolated list (IL) following cue presentation, allowing subjects to possibly reindex the IL with the retrieval cue and partition it off in memory from the original list (OL). So, if one were to eliminate the review of the IL after the retrieval cue is given, the postinformation advantage could disappear. Another explanation of the indirect-postinformation effect was tested in Experiment 1. It is possible that informed subjects realized that they could easily generate the IL and therefore concentrated all of their efforts on recalling the OL (Epstein, 1970). To test for this explanation, the experimenters divided the uninformed group. One half was told that they will recall only the original list (OL), the other half was told that they must recall both lists. If the "OL- only" group performed similarly to the informed group, then one may suspect that the informed subjects performed better after receiving the cue because they did not have to worry about the interpolated list (IL) and so focused attention on the retrieval of the OL. Results did not support either explanation. The indirect-postinformation release from RI clearly occurred in the informed group even without IL review following retrieval cue presentation. Further, the uninformed OL-only group did not outperform the uninformed-both lists group.

The second experiment was conducted so that further support could be garnered for the generalizability of the indirect-postinformation release from RI. There were two design changes in Experiment 2. First, the method was changed so that the letters of each list would appear one by one, instead of each list in its entirety as before. Second, an indirect-preinformed group was created to further examine the relationship between the indirect-postinformation release and other types of release. The preinformed group was told the IL retrieval cue before originally viewing that list, like the group from Zimmerman (1954). They should have encoded the information differently from the OL and thus minimalized the amount of RI. Results were again encouraging. In a serial recall task, the postinformed group outperformed the uninformed, suggesting generalizability of the postinformation effect. Further, the postinformed group recalled slightly more than the preinformed, though the difference was not significant. Also, the preinformed group's recall was not significantly better than the uninformed. Thus, the postinformation effect seems to be robust with lists of letters.

Although these studies essentially provided support for the indirect-postinformation release from RI, the use of serial recall with lists of letters inherently contains several disadvantages (Bower and Mann, 1992). First, the lists invariably share the same letters, rendering study of interlist intrusions quite difficult. Also, there are several possible scoring methods. Bower and Mann (1992) used absolute position, but acknowledged that another method that gives partial credit for correct sequences that are out of overall serial order may be more appropriate. Additionally, a third unpublished serial recall study by Bower and Mann found no evidence of a release from RI. They explained this null result as a by-product of the change in method from memory drum to computer presentation. Subjects encoded the lists as a motor series of key presses instead of actual letters. Concerned about issues such as reliability, validity, and scoring of serial recalls, Bower and Mann changed the stimuli and recall task for the third and fourth experiments.

Experiment 3 attempted to generalize the results of the previous two experiments to the free recall of lists of words. All subjects viewed an OL composed of random U.S. cities, and the experimental groups viewed an IL composed of U.S. cities that were also former U.S. presidents. The latter fact served as the postorganizing cue for the postinformed group. Results were similar to those obtained in the first two experiments. The postinformed recalled significantly more items from the target list than the uninformed, thus supporting the generalizability of the indirect-postinformation release from RI phenomena to word lists.

Bower and Mann (1992) note that a simple editing hypothesis could be invoked to explain the results. This hypothesis suggests that the uninformed subjects confuse the two lists and so cannot easily edit out those cities that are not target cities during retrieval. Conversely, the postinformed subjects can easily edit them based upon the information from the postorganizing cue. This hypothesis predicts that uninformed subjects should make more intrusion errors from the IL than the postinformed. The data did not readily support this prediction though, with the number of IL intrusions for both groups being too small for analysis. The authors recognized the possibility of a more subtle version of this hypothesis - the intrusions from the IL are covert and easily suppressed by the postinformed group. This would grant them more time to search for OL items while the uninformed group would spend significantly more time covertly debating list membership. In the worst case, these subjects might withhold words because they mistakenly believe them to be from the IL or they cannot decide upon list membership. Conversely, the postinformed group would know that any word recalled that is not a former president's name must have been on the OL. This explanation for the recall benefit of the postorganizing cue was tested in Experiment 4.

Additional procedural changes characterized the fourth experiment. First, the subject's final recall was completed without strict regard for list membership, using the modified modified free recall (MMFR) test. The MMFR requires both lists to be recalled, as well as the use of a "Not Sure" column for recalled words with indeterminable list membership. The subtle editing hypothesis would predict a significant boost in the uninformed subject's recall of the OL, because they would no longer need to suppress covertly recalled words. They would be required to list all words learned from the experiment. Another procedural difference arose from experimenter suspicion that some of the uninformed subjects became aware of the IL retrieval cue while learning the IL (i.e., the cities on the IL are also former presidents). They believed that this knowledge could affect the encoding and retrieval of the IL items and so boost recall of the IL and indirectly the OL. The shift release subjects of PI experiments experienced something similar, but their shift occurred during learning of the target material as opposed to the interpolated material. Researchers thus asked the uninformed subjects following the MMFR whether they "noticed anything interesting" about the IL when they studied it originally. Subjects in the uninformed group were then divided for statistical analysis into those who were uninformed-unaware (U-U) an uninformed-aware (U-A). Results were quite similar to those of Experiment 3, with one exception. By classifying the uninformed subjects as either aware or unaware, it was found that the U-A group recalled significantly more than the U-U group, and no differently from the informed group. Thus, the U-A group seemed to show a type of shift release from RI methodologically comparable to that observed by the previously mentioned PI studies, the major difference being that Bower and Mann (1992) utilized indirect cueing. The U-A subjects were obviously able to utilize the category knowledge while learning to significantly reduce the amount of interference between the OL and the IL.

The set of experiments by Bower and Mann (1992) has created many more questions concerning the role of the postinformation release from RI. As they point out, current theories cannot account for their indirect cueing results. Postman and Underwood's (1973) response-set suppression explanation claims that the subjects experience RI because of an inhibition of OL items while learning the IL. Following IL learning, the subjects cannot recall the OL very well due to this suppression. This explanation gives no predictions as to how this suppression could be overcome, as it is by the indirect-postinformed as well as other indirectly cued groups. If any prediction could be made from this explanation, it would be that further information about the IL would only increase the suppression of the OL by priming the IL items before retrieval (Bower & Mann, 1992).

The same prediction as above is made by the second half of the Watkins and Watkins (1975) cue-overloading hypothesis. It clearly states that for a retrieval cue to be effective, it must refer to the target material. But again, the results from Zimmerman (1959) and Bower and Mann (1992) clearly contravene that prediction.

Indirect-cueing groups also counter the logic of part-set / part-list cueing (Nickerson, 1984; Rundus, 1973; Slamecka, 1968), and the list strength effect (Ratcliff, Clark, & Shiffrin, 1990; Shiffrin, Ratcliff, & Clark, 1990; Tulving & Hastie, 1972). In part-set / part-list cueing and list strength experiments, subjects who were reshown or primed with certain list or set items often experienced a decrement in recalling target items other than those that were reviewed or primed. As before, this logic predicts that informed subjects should experience a decrement since the cue would direct the subject's attention toward the IL. Interestingly, the data reveal the opposite effect (Bower & Mann, 1992).

Bower and Mann found no obvious way to account for their indirect-postinformation release in terms of current memory models (SAM, FRAN, ACT, CHARM, TODAM, etc.). The assumption for most of these models is the necessity of the association of the retrieval cue to the target items for recall. But contrary to that assumption, the postinformation cue did not directly refer to the target items and thus could not serve as an additional distinguishing retrieval cue. Further, Bower and Mann (1992) assert that what something is not is usually useless as an additional retrieval cue.

The results also seem to conflict with the principle of encoding specificity (Tulving & Thomson, 1973) which states that in order for a retrieval cue to be effective in recalling an item, the relation of the cue to that item must have been noticed and processed during original learning. A somewhat tentative reconciliation may be achieved if one grants that subjects encode the list items under the general category (for example, "flowers") but also notice the more specific subcategories (for example, "wild flowers" or "garden flowers") during list learning. When the experimenter supplies the specific retrieval cues, subjects are able to recall the items with the active guidance of the cues. The uninformed subjects instead utilize the general category for the recall task and so experience interference. Again, this explanation permits the direct-postinformation release but does not seem viable when considering an indirect-postinformation release. The specific retrieval cues would only focus retrieval efforts upon IL items in an indirect paradigm.

Bower and Mann (1992) predicted that the key to the indirect-postinformation release may lie within the first phase of retrieval, the generation of possible items. They suggested that the IL associations to the experimental context were somehow inhibited during OL memory search (Bower & Mann, 1992), but intimated that theories concerning the postinformation advantage would be premature until further research clarifies its nature and extent.

The need for clarification led to a study by Etgen and Blick (1994, March) which focused on the effectiveness of the indirect-postinformation release at a longer retention interval, and a test of generalization to new word lists.

The basic design of Etgen and Blick (1994, March) was comparable to Experiment 4 of Bower and Mann (1992), with some changes in methodology. A major difference was that the lists were reconstructed to be composed of animals instead of cities. The researchers changed lists because they were concerned about the high percentage of uninformed subjects who became aware in Bower and Mann (1992), experiment 4. The OL contained a random assortment of 12 animals with no apparent logical associations. The IL contained 12 farm animals which were taken from a categorical list generated by 150 students. The IL postinformation cue was thus: "List 2 is composed of farm animals".

An additional change in design involved the exclusion of the typical control group of Bower and Mann (1992), those subjects who learn only the target list. The number of available subjects and time constraints did not allow for such a group. Also, the researchers were confident that the superior recall of subjects who only learned the OL would always occur, as it had in all other studies that utilized such a group. Finally, the U-U (interference-induced) group was considered the control in that it was the group to which all the experimental groups were compared.

The U-A/U-U design was also used by Etgen and Blick (1994, March). One must consider that, following Bower and Mann (1992), any similar experiment must acknowledge and account for the aware subjects. The question that Bower and Mann (1992) asked uninformed subjects was changed slightly for Etgen and Blick (1994, March). Instead of "Did you notice anything interesting about List 2 ?", subjects were asked, "Did you notice anything about either list?". It was stressed that not finding anything interesting was an acceptable answer to this question. The experimenters thought that this approach might better separate those who were sure of the IL clue and those who were somewhat unsure but had briefly entertained the idea. The suspicions of the unsure subjects could be confirmed unintentionally if questioned solely about the IL.

The final method change was the inclusion of a long term retention interval of two weeks. Subjects completed MMFR recall again exactly as they had at the immediate retention interval. The IL retrieval cue was not given again. The two-week interval was added so that the strength of the indirect-postinformation and indirect-awareness releases could be examined over time.

All other points of procedure were essentially the same as Bower and Mann (1992), including the use of the MMFR recall technique and the time designations for word presentation, recall periods, and the distracter task.

Despite the method changes, Etgen and Blick (1994, March) expected to find the same results as Bower and Mann (1992) at the immediate retention interval. The results from the longer retention interval were uncertain, although the researchers believed that the released groups would not experience as much of a recall decrement as the U-U subjects.

The results from the short-term interval were indeed much like Bower and Mann's (1992). Primarily, there was a confirmation of the indirect-postinformation release. The informed group significantly outperformed the U-U group on the recall of the target items. The U-A subjects recalled equally as well as the postinformed (almost identically), and significantly better than U-U, confirming the indirect-awareness release. The "unsure" column of the MMFR was used infrequently by all groups as in Bower and Mann (1992). Thus, it would seem that the indirect-postinformation release and the indirect-awareness release are generalizable to this methodology at the immediate interval.

The results from the long term interval provided an interesting picture of the long-term effects of the indirect-postinformation and indirect-awareness releases from RI. The recall of all groups dropped, but the order of the magnitude of recall stayed the same. The U-A and informed groups continued to exhibit almost identical recall for both lists, with the U-U group far below that level. A nonsignificant difference between the long and short term intervals occurred in the "unsure" column of the MMFR. Both the informed and U-A groups again used it infrequently, but the U-U group used it more often than before. It seemed that much of the memory loss for the U-U group was list designation information, although the U-U subjects also recalled far fewer items overall than before. The recall sheets of these subjects suggested a high degree of random guessing, whereas the other two groups exhibited more "educated" guesses. It seemed as though the two released groups were generating items for both lists from some sort of categorical retrieval cues. One observation that points to this possibility is found in the U-A subject's recall sheets. These subjects were asked, as noted before, to write down anything that they noticed in particular about either list. A clear majority, about 70%, wrote that the OL was a conglomeration of wild animals, in addition to the IL being farm animals. So, it would seem that they had contrived their own positive retrieval cue for that list.

In order to explain the results of the past studies which utilized indirect cueing (Zimmerman, 1954; Bower & Mann, 1992; Etgen & Blick, 1994, March), the following modification to the cue-overloading hypothesis was derived. It provides a reconciliatory solution to the incompatibility problem of indirect-cueing releases with the cue-overloading hypothesis and the major memory models, as well as theoretically places the indirect-cueing release into a relational perspective with other types of releases. The proposed reconciliation is embodied in the following modification to the second half of the cue-overloading hypothesis.

Modification to the Cue-Overloading Hypothesis

The modification was derived from a close examination of the results of the indirect-cueing release from RI experiments mentioned above (especially Etgen & Blick, 1994, March). It specifically outlines an underlying three-step process which describes how an indirect retrieval cue can be utilized by the subject. The following example will specifically deal with the indirect- postinformation release from RI.

In the first step, the IL is categorized by the retrieval cue given by the experimenter. For example, if the cue is that the IL "is farm animals", the subject will automatically revive a few items upon hearing this categorical information (this will be quite simple and effortless because of the recency effect), and analyze the veracity of the statement. Upon recognizing that the cue is true, the IL will be associated in memory with the retrieval cue, "farm animals". This first step is completed in very little time.

The second step begins a much more complicated process. Following the index-cue tagging of the IL, the subject next turns to the OL. An automatic process of comparison seems to occur at this time in which the meaningful relationship of the OL to the IL is assessed. The process first produces a negative index cue. Returning to our example, the negative cue for the OL would be "not a list of farm animals". For all purposes, the subject has devised a different index-cue tag for the OL, but as Bower and Mann (1992) point out, a negative cue should not be as effective for retrieval as a more definite positive cue. So, the subject attempts to discover a more descriptive associative relationship between the OL and IL. The subject tries to devise a positive cue for the OL to replace the negative cue by engaging in the item testing process described in the first step. For example, "If the IL is farm animals, and OL is not farm animals, then the OL must be (test a few items from memory) ..... wild animals". This new positive cue will serve as the index cue association for the OL, just as "farm animals" served as the index cue association for the IL.

A discussion is now in order concerning Bower and Mann's (1992) claim that negative cues are ineffective as retrieval cues. Their logic for this claim lies in the reasoning that the negative cue would only set aside a small fraction of information that would not be helpful in generating the OL. For example, the set of items in the OL are "not farm animals", but the amount of animals that are "not farm animals" is too vast to be helpful. Also, the collection of items in general that are "not farm animals" is practically infinite (i.e. names of cars, football teams, dinosaurs, etc). The logic of those statements do not hold when one considers priming.

Addressing the second statement, the collection of items that are "not farm animals" but are other various items would not even be considered by the subject, mainly because the general category cue is always available ("lists of animals"). Addressing the first statement, the spatiotemporal information that is encoded in the subjects memory during list presentation is still quite fresh in the subject's mind. Because certain animals were presented (primed) to the subjects, these same animals would most likely be generated at recall. Brown's (1968) generation study provides support for this idea. In his study, the priming of certain items before a generation task increased the likelihood of those items being recalled. Therefore, it is possible the negative cues may have viability as retrieval cues when combined with spatiotemporal and contextual cues. The negative cue is all that the subject has to fall back upon during the second step of the modification, if no positive cue is apparent for the OL. So, in Etgen and Blick (1994, March), the 30% of U-A subjects who did not mention a subcategory retrieval cue for the OL most likely used a negative retrieval cue in combination with spatiotemporal and contextual cues. As a logical extension of positive vs. negative cue classification, a positive cue is probably preferable to a negative one, as is demonstrated by the clear majority of U-A subjects. This preference may be due to the fact that a negative retrieval cue is much more spatiotemporally and contextually dependent than a positive cue. That is, a negative cue relies heavily on the contextually-dependent priming of the words from original learning, whereas the positive cue needs very little spatiotemporal and contextual information to be effective. The contextual dependency of negative retrieval cues implies that they may be weaker at longer intervals, although essentially equal at short ones.

The final step is the actual association of the OL with its appropriate index cue. This index cue may be either positive or negative as noted above. Again, a positive cue would be ideal but a negative cue would suffice in the short-term.

The process outlined above can be simplified to account for both the indirect-preinformation and awareness releases. In a preinformation release, the subject is given the first step of the process by the experimenter before learning. The supplied cue permits the preinformed subject to encode the IL with its appropriate retrieval cue. The second and third steps, in which the retrieval cue for the OL is created, are still necessary though. The process for awareness released subjects is essentially a mixture of those for the preinformation and postinformation releases. Aware subjects will encode the latter items of the IL as though preinformed, but earlier items must be revived and associated to the retrieval cue in the same manner as a postinformed release. The second and third steps are again necessary for an indirect release to occur.

Before turning to the hypotheses and design of the present experiment, a further problem with some studies of the release from interference must be addressed. As noted by Bower and Mann (1992), some of the subjects will process the IL under the experimentally-given retrieval cue during the learning phase of an experiment. Thus, in a release from interference design, awareness-releases will always occur and could provide researchers with far different data than they believe if they are unaware of this event. Again, the direct-awareness release from interference has been frequently found and manipulated in PI experiments (see Wickens, 1970), but an indirect-awareness release had not been documented in either PI or RI designs until Bower and Mann's (1992) release from RI study. The awareness release has only been documented in subjects who remain uninformed by the experimenter. All postinformation release studies have neglected the fact that some of the subjects in the informed group most likely became aware of the cue before it was given to them as well. Certainly this would lead to differential IL list processing within that group just as in the uninformed group, but how would a confirmation of the subject's own IL retrieval cue by the experimenter effect recall?

Let us for a moment contemplate the first half of the cue-overloading hypothesis. A cue for the recall of a particular unit becomes less effective as more units are associated to that cue, and the less distinctive it is from other cues. Certainly the number of alternative memory units associated to the general categorical cue given at the start of the experiment ("you will learn a list of 'animals' ") should decrease when the IL is originally processed under the more specific subcategory cue. The result is an awareness release as found in some of the uninformed subjects in Bower and Mann (1992) and Etgen and Blick (1994, March). The recall of an informed-aware group (I-A) could also be significantly different from that of the informed-unaware (I-U). Perhaps those subjects who were aware and informed skewed the data positively for the entire informed group. Perhaps, as in Bower and Mann (1992) and Etgen and Blick (1994, March), the clear majority of subjects in both the uninformed and the informed were aware during processing. This could certainly skew the data positively. Separating the data of the informed group may provide us with a much clearer picture of the indirect-postinformation release. It may be that the subjects who were aware and then also informed of the IL cue experienced a release that was superior to those unaware and informed subjects. It is unknown whether or not becoming aware before being informed would boost recall significantly over those who experienced only one or the other. Investigation of the informed subjects' recall distributions revealed no bimodal tendencies (Etgen & Blick, 1994, March), so a preliminary prediction may be that the extra information does not affect recall. The following study made the awareness distinction in the informed group in order to investigate the possible effect of cue-awareness upon informed subjects' recall.

The present study had a design much like that of Bower and Mann (1992) and Etgen and Blick (1994, March), the focus being the indirect-postinformation and indirect-awareness releases from RI. It tested the following predictions as suggested by the proposed modification to the cue-overloading hypothesis.

First, it was necessary to demonstrate that the indirect-postinformation and indirect awareness releases from RI occurred. A comparison of the short-term interval recall of the three released groups (I-U, I-A, and U-A) with the U-U group provided that information. The recall of the released groups should be significantly higher than that of the interference group. Further, the short-term recall of the I-A group was compared to the I-U and U-A groups so that the release experienced by the informed subjects who are also aware during learning could be examined. It was predicted that the

I-A subjects would not differ in degree of release from the other released groups because no bimodal tendencies in the distribution have been observed in the past.

The first prediction made by the modification posits that released subjects will utilize both positive and negative retrieval cues for the recall of the OL. There should be no difference between the recall of those subjects who use the positive and those who use the negative cues at the immediate retention interval. The second prediction holds that negative cues become less effective for recall at longer retention intervals. Thus, those subjects who use a negative retrieval cue should experience a greater rate of forgetting as compared to those who use a positive cue, and should have lower recall at the two-week interval.

Method

Subjects

Subjects were 79 University of Richmond undergraduates who were given Introductory Psychology research credit for their participation. Subjects were tested in groups of 20, with each group assigned to one of two conditions. Conditions were randomly selected by the researcher before the group was tested. Subjects were treated in accordance with the Ethical Principles of the APA.

Materials

List 1 (OL) was composed of the 12 most frequently occurring four-footed, non-farm animals as taken from Battig and Montague's (1969) category norms for verbal items. List 2 (IL) was composed of the 12 most frequently occurring farm animals as taken from a comparison of Battig and Montague's list with a list generated by 150 psychology students at the University of Richmond. The words from both lists (see Appendix for both lists) were typed and photographed from equal distance so that each were presented with the same size and orientation in a slide projector. Subjects were supplied with four blank pieces of paper for recall and the distracter task.

Procedure

At the beginning of the session, each subject was given a consent form and four blank pieces of paper. They were then told, "Please read and sign the consent form, and look at me when you are finished". The experiment began when all subjects completed signing the consent form.

All subjects were told, "In this experiment, you will be asked to learn two lists, both of which are composed entirely of four-footed animals. Each list will be presented twice. Following the second presentation, you will be given one minute to recall that list. Are there any questions? If not, we will now begin with the first list."

Subjects viewed the first list twice. Each word was presented individually for 5 s, totaling 2 min for complete presentation. Following presentation, subjects were given 1 min for recall of the OL. The presentation of the IL was the same as for the OL, with recall completed on a different page. After the IL presentation, subjects were told, "I want you to write on the back of the second list recall sheet whether or not you noticed anything in particular about either list. If you did not, that is fine because there may or may not have been anything noticeable about either list." This question distinguished those aware subjects from those who were unaware of list categorization during original learning.

All subjects then engaged in a nonverbal distracter task. This task consisted of rating a series of cartoons for degree of humor on a 10-point scale, with 1 = very funny and 10 = not funny. Again, cartoon ratings were completed on a different page. “Please read the following cartoons and rate each one for funniness on a 7 point scale, 1 is very funny and 7 is not funny at all. You will have 30 seconds to read and rate each cartoon, number your third page write your ratings next to the appropriate cartoon number.” Twelve cartoons were presented for 30 s each, totaling 6 min for the distracter task.

Following the distracter, but immediately before the recall of the target list, informed subjects received the cue about the IL. They were told, “Now I will give you a hint about one of the lists, the second list was composed entirely of farm animals. Please turn to your last blank piece of paper and recall the first list that you learned. You do not have to place them in order, and you will be given 5 minutes to do this. Do not turn to any of the previous pages while recalling.” Uninformed subjects received no cue. Immediately after the distracter task, they were told to “Please turn to your last blank piece of paper and recall the first list that you learned. You do not have to place them in order, and you will be given 5 minutes to do this. Do not turn to any of the previous pages while recalling.”

After this recall, subjects were asked basically the same question as was asked before about the lists. Informed subjects were told, "Turn your final recall sheet over and write down whether you noticed anything about the first list, again there may be nothing noticeable about it." Uninformed subjects were told to "Turn your final recall sheet over and write down whether you noticed anything in particular about either list. Again, if you did not, that is fine because there may or may not have been anything noticeable about either list." . These questions served to distinguish between those released subjects who used positive cues (semantically oriented, meaningful categorical relationship with IL) and those who used negative cues (episodically oriented, negation of IL cue) for retrieval. Subjects were then told, "That completes the first part of this experiment, please come back to the same room at the same time two weeks from now for the second part. If you do not return, you will receive a no-show."

Following a two week interval, subjects returned to the same room at the same time of day for a second OL recall. Recall was completed in the same format as before. Subjects were told, "Please take a single sheet of paper. Now recall the first list that you learned two weeks ago." The IL retrieval cue was not given again, and no further questions about the lists were asked. After this recall was complete, the subjects were debriefed and dismissed.

Results

A priori comparisons were completed at the .05 significance level on the immediate retention interval recall of the groups. The first comparison between the released groups (I-A, I-U, and U-A) and the interference group (U-U) was significant, $F(1,75) = 6.29$, $MSe = 22.64$, $p = .014$. The second comparison between the I-A group and the other released groups (I-U and U-A) was not significant, $F(1,75) = .11$, $MSe = 22.64$, $p = .75$. Means for all groups at the immediate retention interval are displayed in Figure 2.

Insert Figure 2 about here

A mixed design analysis of variance was completed on the immediate and long-term interval recall data of the released subjects who had used either positive or negative retrieval cues.

A significant main effect of retention interval was observed,

$\underline{F}(1,59) = 66.854$, $\underline{MSe} = 1.23$, $\underline{p} < .001$, with the recall at the immediate interval ($\underline{M} = 10.21$) higher than the recall at the two-week interval ($\underline{M} = 8.629$). The main effect of cue-type was not significant, $\underline{F}(1,59) = 1.62$, $\underline{MSe} = 5.67$, $\underline{p} = .208$, with the average recall of positive cue users ($\underline{M} = 9.61$) only slightly higher than the negative cue users ($\underline{M} = 9.03$).

There was a significant interaction between retention interval and cue-type, $\underline{F}(1, 59) = 4.02$, MSe = 1.23, $\underline{p} =.049$. Simple effects revealed no difference between the groups at the immediate interval, $\underline{F}(1,118) = .05$, MSe = 3.46, $\underline{p} = .96$; and a strong, but nonsignificant difference at the two-week interval, $\underline{F}(1,118) = 3.70$, MSe = 3.46, $\underline{p} = .06$. Means for both groups at the immediate and long-term retention intervals are displayed in Figure 3.

Insert Figure 3 about here

The interaction indicated that the positive cue users displayed a lower rate of forgetting than the negative cue users over the two-week retention interval, although the difference was nonsignificant.

Discussion

The results from the first a priori comparison indicated that the I-A, I-U, and U-A groups were released from the RI that the U-U group experienced, as was expected. The second comparison revealed that those informed subjects who were aware of the IL retrieval cue while learning recalled no more than the other two released groups (I-U, U-A). It seems that a combination of the two releasing mechanisms (subject-awareness or an experimenter-supplied cue) provided no additional boost in recall. Thus, the I-A subjects were released primarily by the awareness factor, with the informed factor having little or no particular relevance to recall outcome. One may then suggest that the informed subjects who were also aware should be technically classified as indirect-awareness released subjects since the experimenter-supplied information was of no consequence. Additional studies of the release from interference should take subject awareness into account for both informed and uninformed subjects, possibly pooling the aware subjects from both groups for analyses. Some type of post-test probe would be necessary in light of the results of the present study.

Overall, if the results from the a priori comparisons and the results of other researchers (Bower & Mann, 1992; Etgen & Blick, 1994, March) are viewed within the previously proposed framework, one may see a general tendency for all types of release to produce equal degrees of recovery. For instance, evidence has been presented which suggests that the indirect-preinformation, indirect-awareness, and indirect-postinformation releases are essentially equal in degree of release (Bower & Mann, 1992; Etgen & Blick, 1994, March). Research with PI has also implicated an equal degree of release for direct-awareness and direct-postinformation releases (Gardiner, Craik & Birtwistle, 1972), but no comparisons of the direct-awareness release with either of the above have been documented. Although the equality of the releases is not specifically noted in the proposed framework, it should now be considered a viable hypothesis.

Results provided support for the proposed modification to the cue-overloading hypothesis, although the nonsignificant simple effect at the two-week retention interval made the support more tentative. As was predicted, the rate of forgetting for the subjects who used positive retrieval cues was not as great as those who used negative cues. Thus, the positive cue users seemed to rely more upon an effective semantic retrieval cue and less upon contextual (episodic) cues to generate the target items, that is, they generated items from their own specific retrieval cue (such as wild or jungle animals). Conversely, the negative cue users did not find a positive semantic retrieval cue and so were forced to rely upon a less effective, negative semantic cue (not a farm animal, or not a domesticated animal) and much more upon contextual (episodic) retrieval cues. Contrary to Bower and Mann's hypothesis (1992), the basis of the cue (semantic or episodic) made no difference at the immediate retention interval because the contextual information about the target items was still relatively fresh in memory. At the long-term retention interval, the contextual cues began to lose their effectiveness and so those who relied more upon semantic cues recalled more items. Therefore, Bower and Mann (1992) may have underestimated the power of contextual retrieval cues at the short-term interval, but were correct when considering the long-term interval.

Results of experiments utilizing direct cues are readily explained by the original cue-overloading hypothesis: the information about the target items is either realized or given by the experimenter and so releases subjects from interference by providing a specific retrieval cue for the target items. But, the cue-overloading hypothesis cannot explain the results of experiments with indirect cueing unless it incorporates the proposed modification. More specifically, the second half of the cue-overloading hypothesis must be modified to include a statement such as this : "Interference will be reduced the more the retrieval cues given during retention testing more clearly specify or index the desired targets. The indexing of target material may be achieved by information that refers specifically to either the target items or the interfering items. The indexing information will create a distinction with either positive or negative retrieval cues. Both types are particularly effective in the short-term, but negative cues will become less effective over longer retention intervals. " The modification to the cue-overloading hypothesis therefore must be added for it to serve as a viable explanatory tool within the general area of the release from interference.

The directions for future research are clear. One need only look to the release from interference framework (see Figure 1 and pages 6 - 8) to discover those areas needing empirical support. The types of interference that have not been thoroughly examined are mostly those within the PI-Indirect and RI-Direct branches of the diagram. Further examination of these types should reveal a similar degree of release to those that have been empirically supported.

Other predictions of the modified cue-overloading hypothesis should be tested. For instance, varying the retention interval to times other than two weeks could determine whether there exists a function which could predict the relative strength of negative and contextual cues at different points in time. Also, a much longer retention interval could be useful in finding whether positive cue users could at some point rely solely and successfully upon a semantic retrieval cue. In that case, they would be generating the list entirely from the retrieval cue with very little or no episodic or contextual information available. As in the present study, the prediction would remain that the recall of the negative cue users should drop faster as the retention interval gets longer.

When expanding upon the research presented here, some design modifications may be in order. The use of an effective set of stimuli is by far the most important consideration. In the present experiment, the stimuli were somewhat comparable to those used by Etgen and Blick (1994, March). The difference between the stimuli was the exclusion of animals from Etgen and Blick's (1994, March) target list that cannot be characterized as "four-footed" in favor of animals that can (for instance, snake was replaced with fox). The logic behind this modification was to create an even more potent general category cue for both lists (four-footed animals) as opposed to an extremely general category cue (animals). It was thought that this would spread out the recall distribution by creating a more interference-inducing task, as well as bring down the number of aware subjects to a more reasonable level (50% or less). It is obvious that the modification did not fulfill its purpose in the present experiment. All groups actually recalled much more than the comparable groups in Etgen and Blick (1994, March). The fact that significant differences between the released and unreleased groups were found in this experiment is a testament to the robust effects of the releases from RI. Besides the careful selection of stimuli, a further consideration arises when examining the performance of subjects over a long-term interval. A colleague has suggested that the experimental design should not involve repeated measures (N.J. Slamecka, personal communication, March 31, 1994). If one is not interested in the rate of forgetting, as in Etgen and Blick (1994, March), then independent observations or a between-subjects design would indeed be more suitable. But again, if one is studying the modified cue-overloading hypothesis in which rate of forgetting is an important factor, then repeated observations would be appropriate. Thus, it may be best not to examine both the comparability of types of release and the modified-cue overloading hypothesis in the same experiment.

In conclusion, much more research needs to be conducted in order to give both the release from interference framework and the modified cue-overloading hypothesis further recognition and empirical support. If both help to foster and rekindle the interest in interference research, then they will have served their theoretical purposes.

References

Baldwin, R. (1969). Release from PI and the physical aspects of words. Unpublished master's thesis. Ohio State University.

Battig, W.F., & Montague, W.E. (1969). Category norms for verbal items in 56 categories: A replication and extension of the Connecticut category norms. Journal of Experimental Psychology Monograph, 80 (3, Pt. 2).

Bower, G.H. (1969). Chunks as interference units in free recall. Journal of Verbal Learning and Verbal Behavior, 8, 610-613.

Bower, G.H., & Mann, T. (1992). Improving recall by recoding interfering material at the time of retrieval. Journal of Experimental Psychology, 18, 1310-1320.

Brent, S. (1965). Organizational factors in learning and remembering: Functional unity of the interpolated task as a factor in retroactive interference. American Journal of Psychology, 78, 403-413.

Brown, J. (1968). Reciprocal facilitation and inhibition in free recall. Psychonomic Science, 10, 41-42.

Epstein, W. (1970). Facilitation of retrieval resulting from post-input exclusion of part of the input. Journal of Experimental Psychology, 86, 190-195.

Etgen, M.P. & Blick, K.A. (1994, March). Release from retroactive interference facilitated by cue-guided generation. Paper presented at the meeting of the Southeastern Psychological Association, New Orleans, LA.

Gardiner, J.M., Craik, F.I.M., & Birtwistle, J. (1972). Retrieval cues and release from proactive inhibition. Journal of Verbal Learning and Verbal Behavior, 11, 778-783.

Loess, H. (1967). Short-term memory, word class and sequence of items. Journal of Experimental Psychology, 74, 556-561.

McGeoch, J.A. (1942). The psychology of human learning. New York:Longmans, Green, and Company.

Muller, G.E., & Pilzecker, A. (1900). Experimentalle Beitrage zur Lehre vom Gedachtnis. Zeitschrift fur Psychologie, 1, 1-300.

Nickerson, R.S. (1984). Retrieval inhibition from part-set cueing: A persisting enigma in memory research. Memory and Cognition, 12, 531-552.

Osgood, C. E., Succi, G.J., & Tannenbaum, P.H. (1957). The measurement of meaning. Urbana: University of Illinois Press.

Postman L., & Underwood, B.J. (1973). Critical issues is interference theory. Memory and Cognition, 1, 19-40.

Ratcliff, R., Clark, S.E., & Shriffin, R.M. (1990). List-strength effect: I. Data and discussion. Journal of Experimental Psychology: Learning, Memory, and Cognition, 16, 163-178.

Reutener, D. (1969). Background, symbolic, and class shift in short-term memory. Unpublished doctoral dissertation, Ohio State University.

Rundus, D. (1973). Negative effects of using list items as recall cues. Journal of Verbal Learning and Verbal Behavior, 12, 43-50.

Shiffrin, R.M., Ratcliff, R., & Clark, S.E. (1990). List-strength effect: II. Theoretical mechanisms. Journal of Experimental Psychology: Learning, Memory, and Cognition, 16, 174-195.

Slamecka, N.J. (1968). The examination of trace storage in free recall. Journal of Experimental Psychology: Learning, Memory, and Cognition, 76, 504-513.

Swanson, J. (1969). Preprocessing on the basis of frequency occurrence. Unpublished manuscript.

Tulving, E., & Psotka, J. (1971). Retroactive inhibition in free recall: Inaccessibility of information available in the memory store. Journal of Experimental Psychology: Learning, Memory, and Cognition, 87, 1-8.

Tulving, E., & Hastie, R. (1972). Inhibition effects of intralist repetition. Journal of Experimental Psychology, 92, 297-304.

Turvey, M.T., & Egan, J. (1969). Contextual change and release from proactive interference in short-term verbal memory. Journal of Experimental Psychology, 81, 396-397.

Underwood, B.J., & Richardson, J. (1965). Some verbal materials for the study of concept formation. Psychological Bulletin, 53, 84-95.

Watkins, O.C., & Watkins, M.J. (1975). Buildup of proactive inhibition as a cue-overload effect. Journal of Experimental Psychology: Human Learning and Memory, 104, 442-452.

Wickens, D.D. (1970). Encoding categories of words: An empirical approach to meaning. Psychological Review, 77, 1-15.

Wickens, D.D., Born, D.G., & Allen, C.K. (1963). Proactive inhibition and item similarity in short-term memory. Journal of Verbal Learning and Verbal Behavior, 2, 440-445.

Wickens, D.D., & Clark, S.E. (1968). Osgood dimensions as an encoding class in short-term memory. Journal of Experimental Psychology, 78, 599-604.

Zimmerman, C. (1954). Cognitive mapping and resistance to interference in memory. Unpublished doctoral dissertation, Department of Social Relations, Harvard University, Cambridge, MA.

Figure Caption

Figure 1. Proposed theoretical framework for the study of the release from interference.

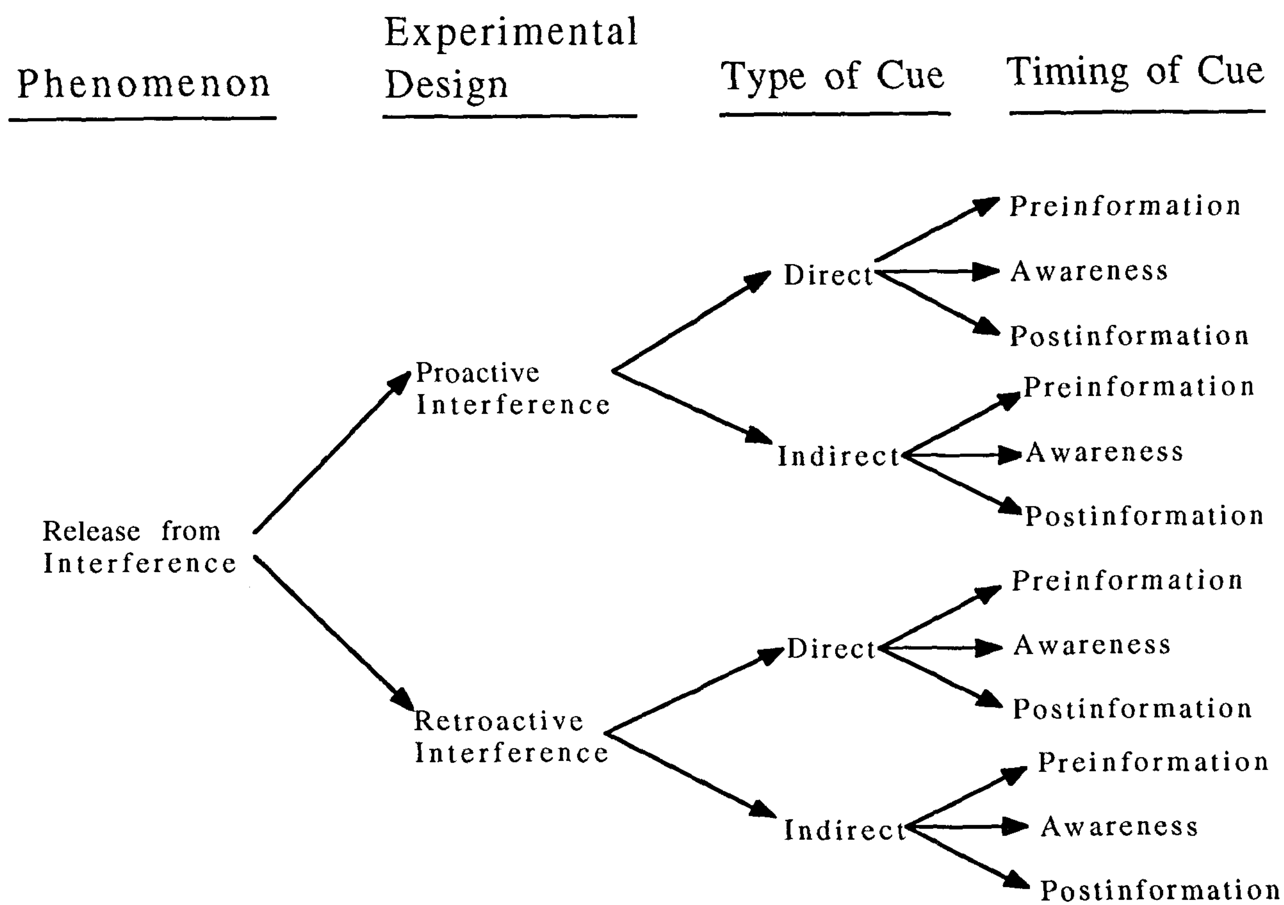

Phenomenon
Experimental Design
Type of Cue
Timing of Cue
Release from Interference
Proactive Interference
Retroactive Interference
Direct
Indirect
Direct
Indirect
Preinformation
Awareness
Postinformation
Preinformation
Awareness
Postinformation
Preinformation
Awareness
Postinformation
Preinformation
Awareness
Postinformation

Figure Caption

Figure 2. Mean recall of all groups at the immediate retention interval.

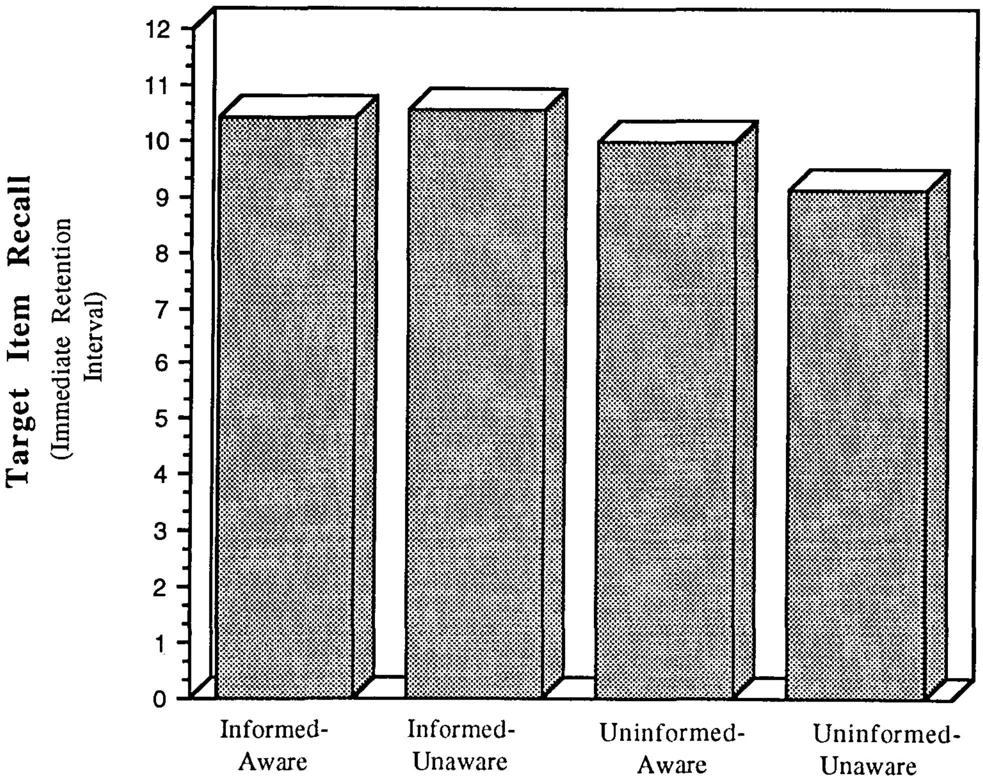
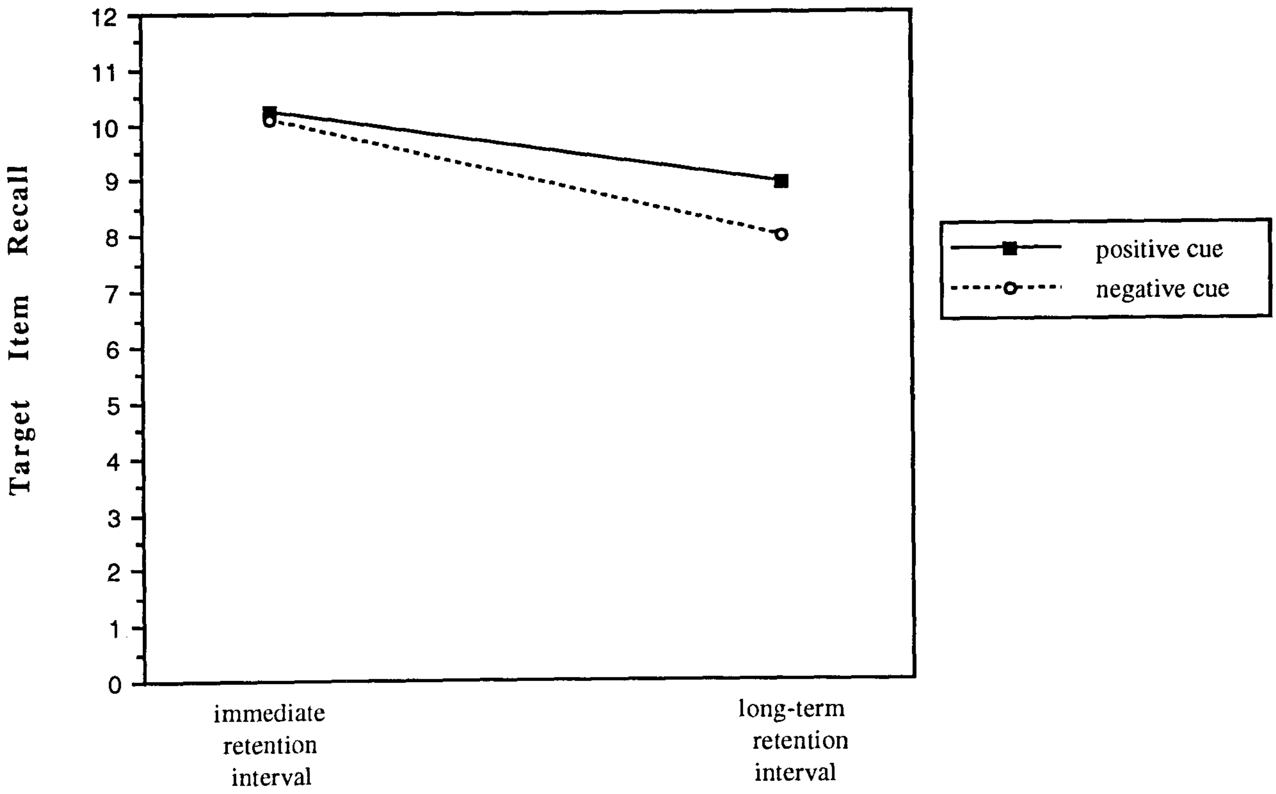

Target Item Recall
(Immediate Retention Interval)
12
11
10
9
8
7
6
5
4
3
2
1
0
Informed-Aware
Informed-Unaware
Uninformed-Aware
Uninformed-Unaware

Figure Caption

Figure 3. Plot of the interaction between retention interval and cue type.



Target Item Recall
0
1
2
3
4
5
6
7
8
9
10
11
12
immediate retention interval
long-term retention interval
positive cue
negative cue

Appendix

Four-Footed Animals in List 1 and List 2

List 1 - lion, tiger, elephant, bear, fox, deer, giraffe, zebra, squirrel, wolf, leopard, and moose.

List 2 - dog, cat, horse, cow, pig, sheep, goat, donkey, bull, lamb, rabbit, and mouse.

Vita

The author is a native of Missouri City, Texas. He received his B.S. in Psychology from the College of William and Mary in May of 1992. He will receive his Mater of Arts in Psychology from the University of Richmond in May of 1994, and will begin the Applied Experimental Psychology PhD program the following fall.